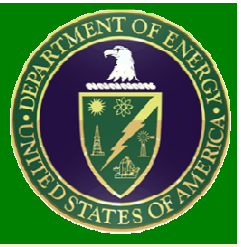
CA CHP GHG Abatement



Contribution of Medium-Sized Commercial Buildings

by

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http://der.lbl.gov / http://www.chpcenterpr.org

California Energy Commission - 23 July 2009

Team: ***Chris Marnay, Michael Stadler, Judy Lai, Tim Lipman, Gonçalo Cardoso, Olivier Megel, and Srirupa Ganguly***

Environmental Energy Technologies Division

Outline

- Study Overview
- DER-CAM Overview, the **D**istributed **E**nergy **R**esources **C**ustomer **A**doption **M**odel
- CEUS Database
- Results for Medium-Sized Commercial Buildings
- PRAC Update
- "Appendix": More CEUS / Result Background

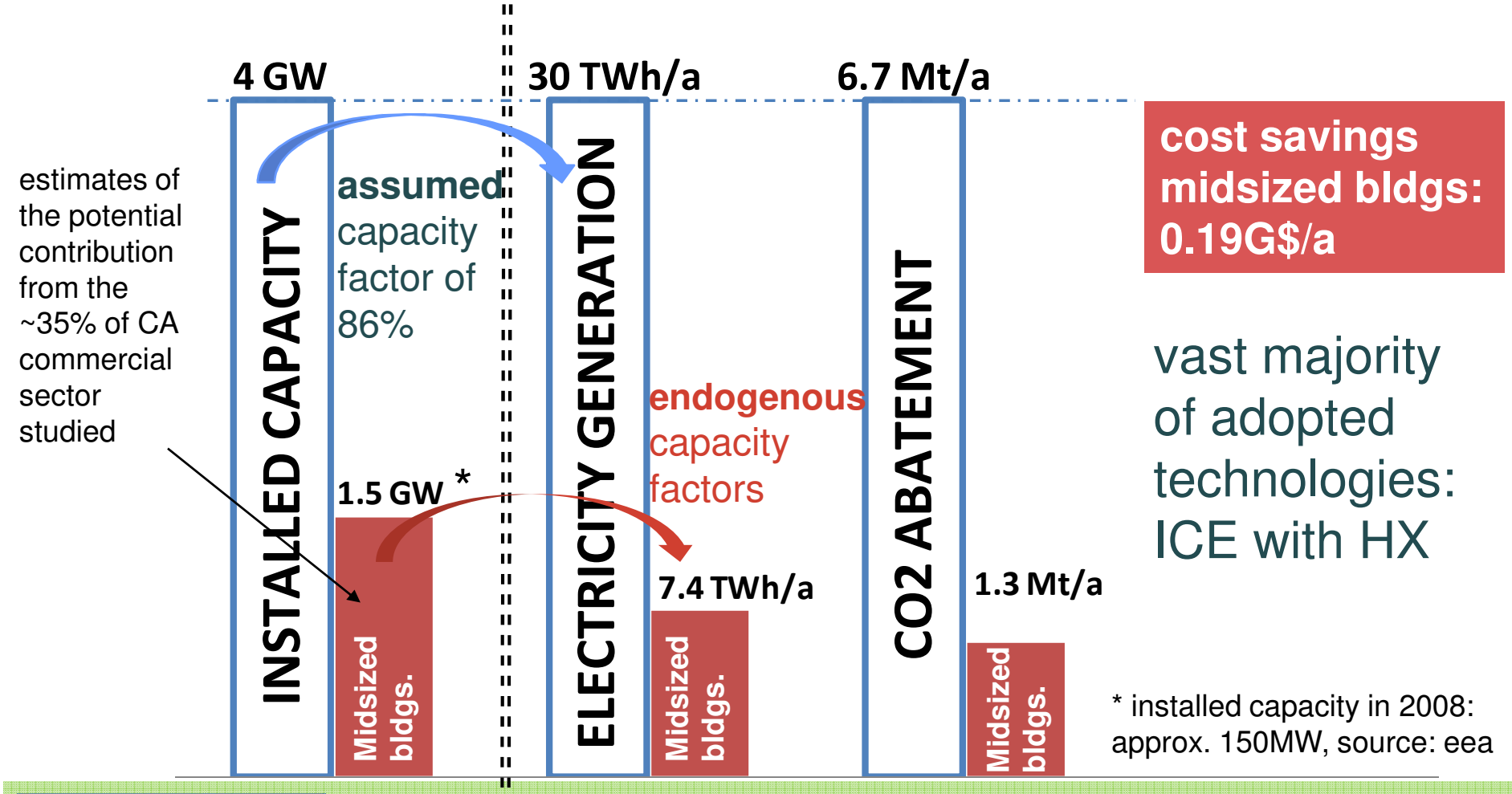
Study Overview: CHP in CA Medium-Sized Commercial Buildings

Study Summary

- objective: to estimate the 2020 CO_2 abatement potential of CHP for medium-sized CA commercial buildings (100 kW – 5 MW electric peak load)
- pick a sample of representative buildings from CEUS
- use DER-CAM to examine CHP attractiveness in sample, with competition from other technologies, e.g. PV
- estimate and report CO_2 results relative to CARB goals
- model reference case and alternative scenarios including carbon taxes and “feed-in tariff” (FiT) cases in relation to AB 32 and AB 1613
- propose further work in this under-explored sector

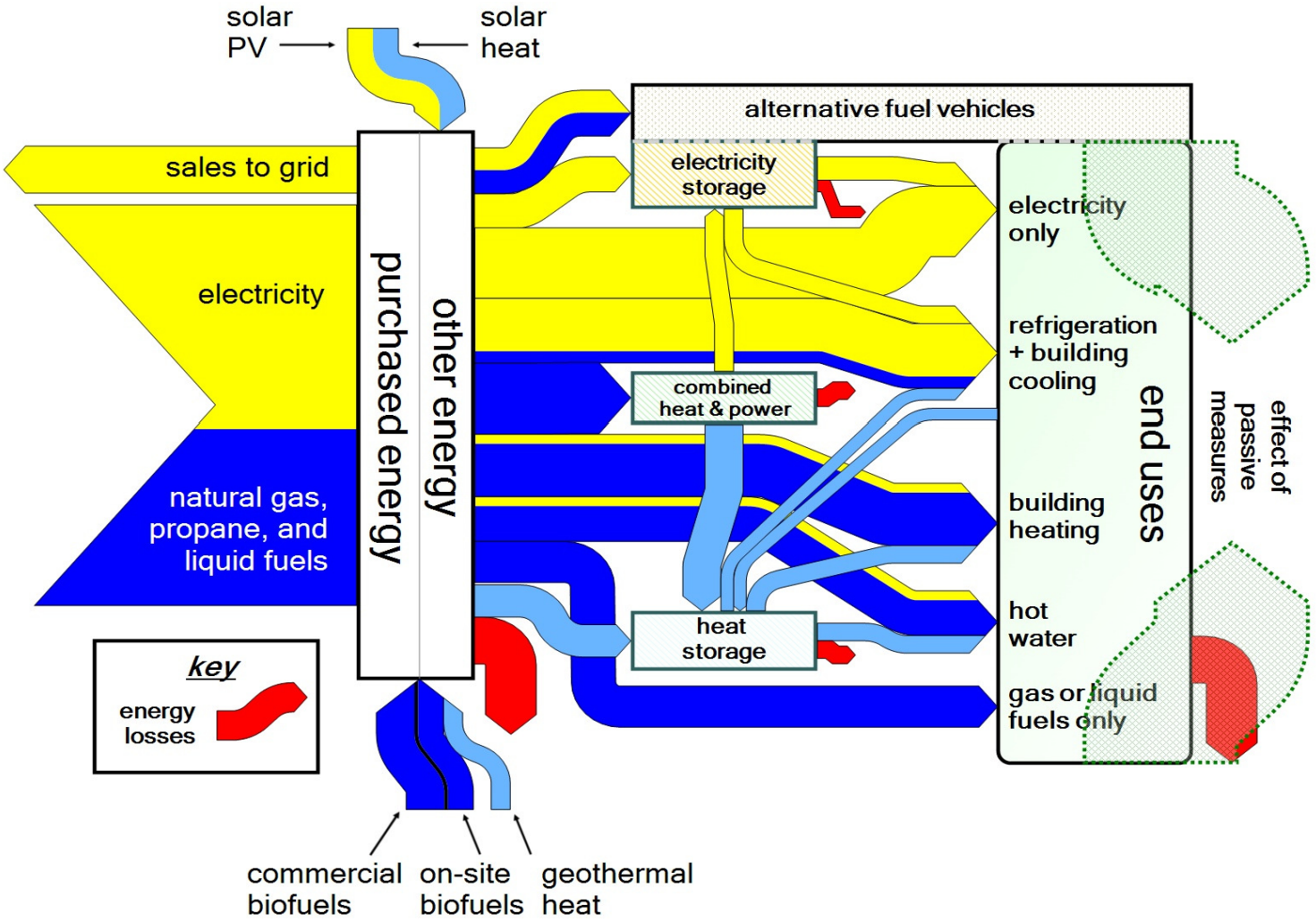
Results Summary
(Reference Case)

Incremental 4 GW CHP CARB 2020 GOAL



Distributed Energy Resources Customer Adoption Model (DER-CAM)

DER-CAM Concept



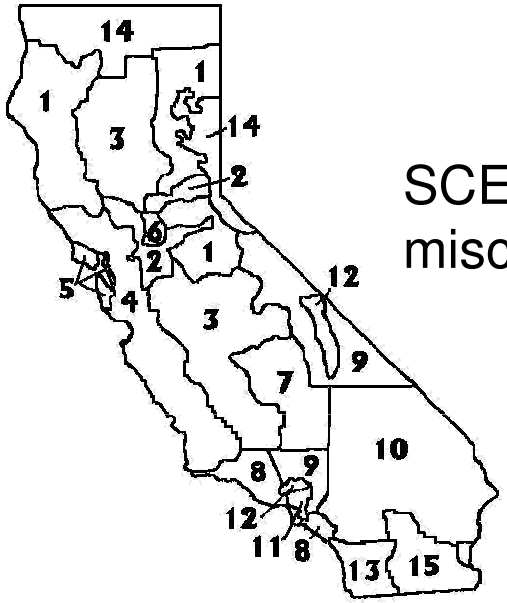
Key Features DER-CAM

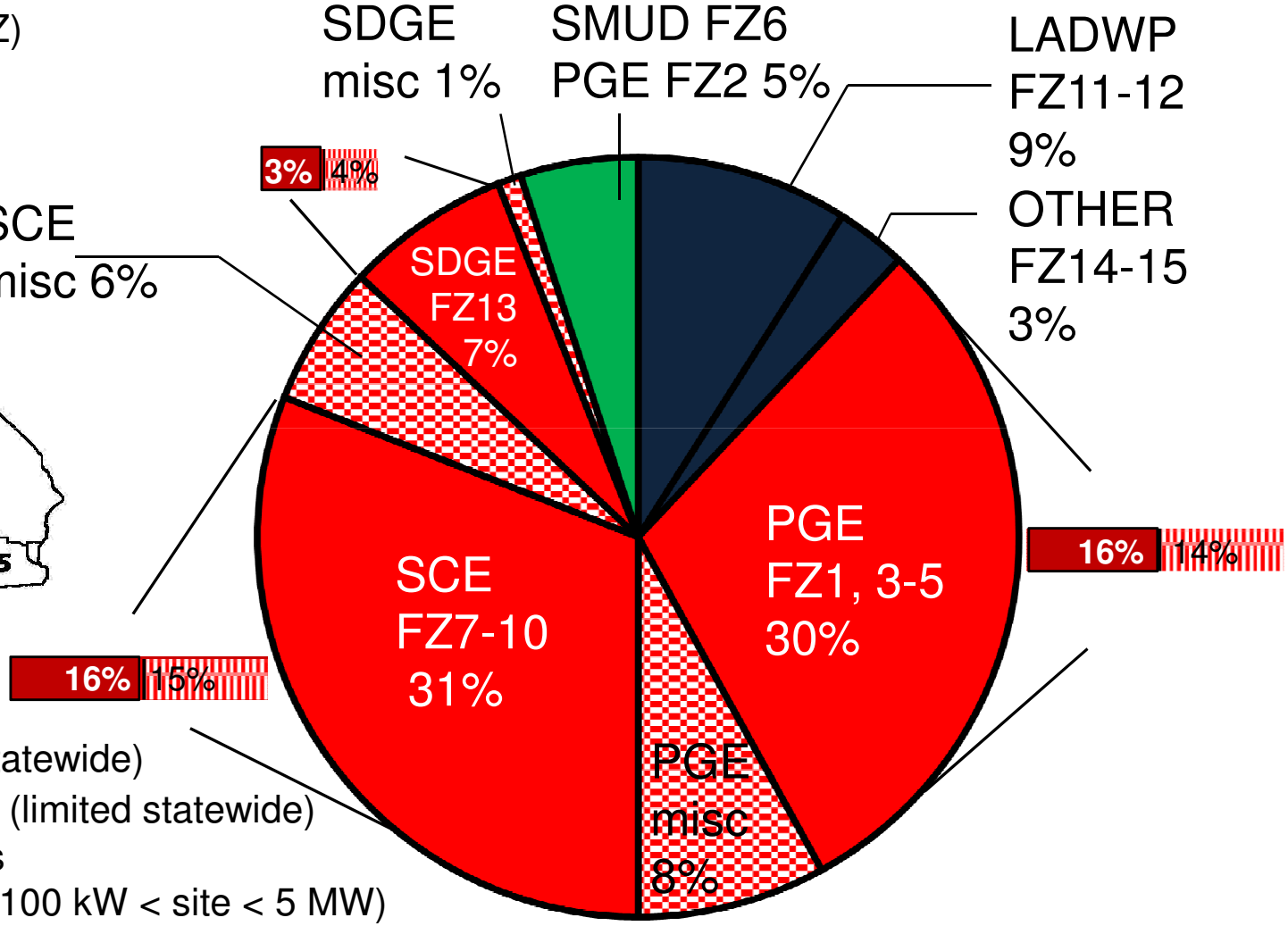
- considers multiple technologies as CHP, PV, solar thermal, and storage at the same time
- optimizes costs and / or CO_2 emissions
- uses a bottom up approach, every single building is considered in detail
- can also analyze zero-net energy buildings by adding that as a constraint

CEUS Database

35% of Commercial Electric Demand

Forecasting zones (FZ)





California (statewide)

CEUS study (limited statewide)

excluded sites

studied sites (100 kW < site < 5 MW)

Building Data Sample

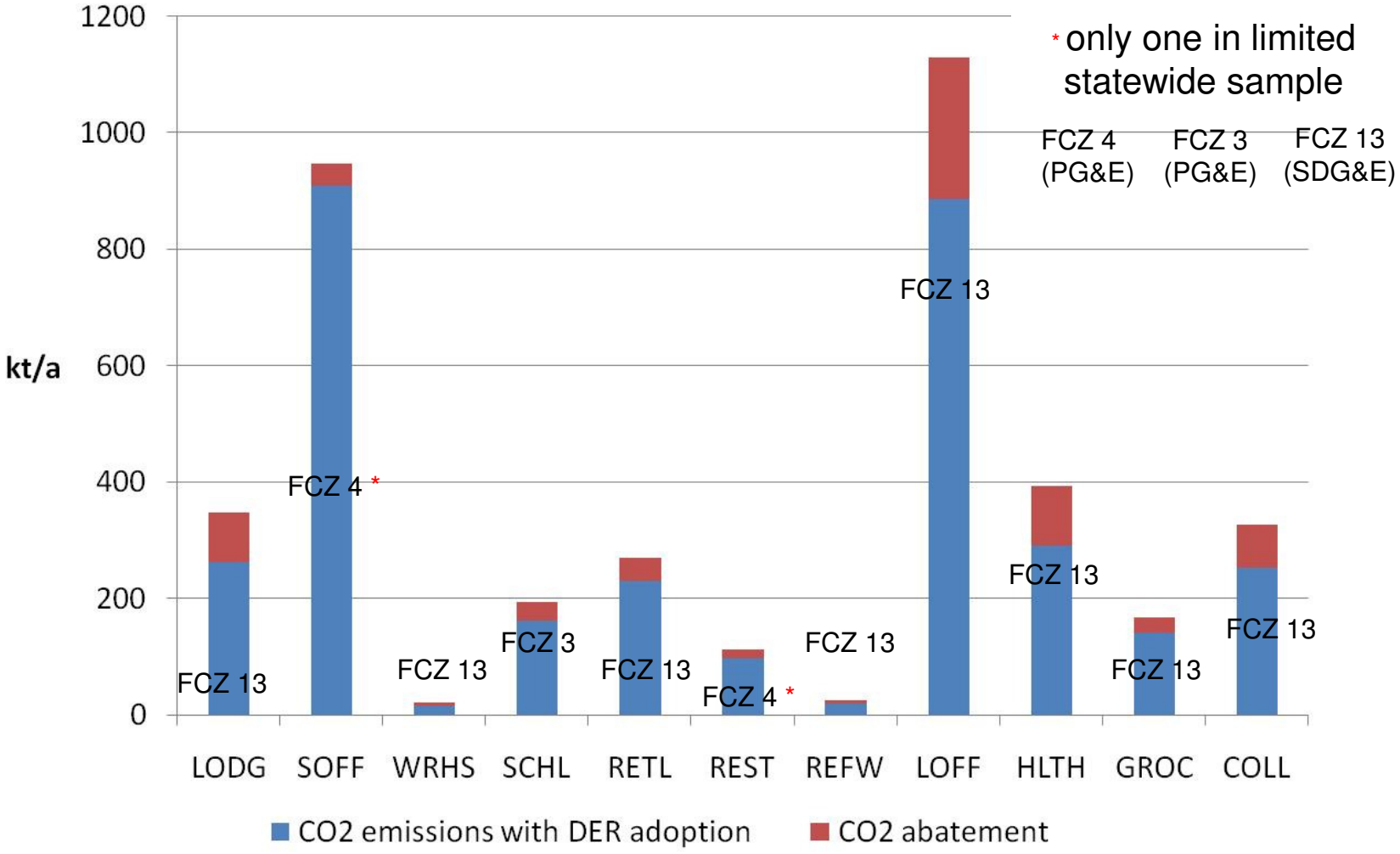
- Objective: to estimate the 2020 CO_2 abatement potential of CHP for medium-sized CA commercial buildings (100 kW – 5 MW electric peak load)
- Scope: buildings with electricity peak within range of 100 kW – 5 MW (35% of total electric demand)
- Building sample: 138 buildings of different types and in various climate zones

Results for Medium-Sized Commercial Buildings

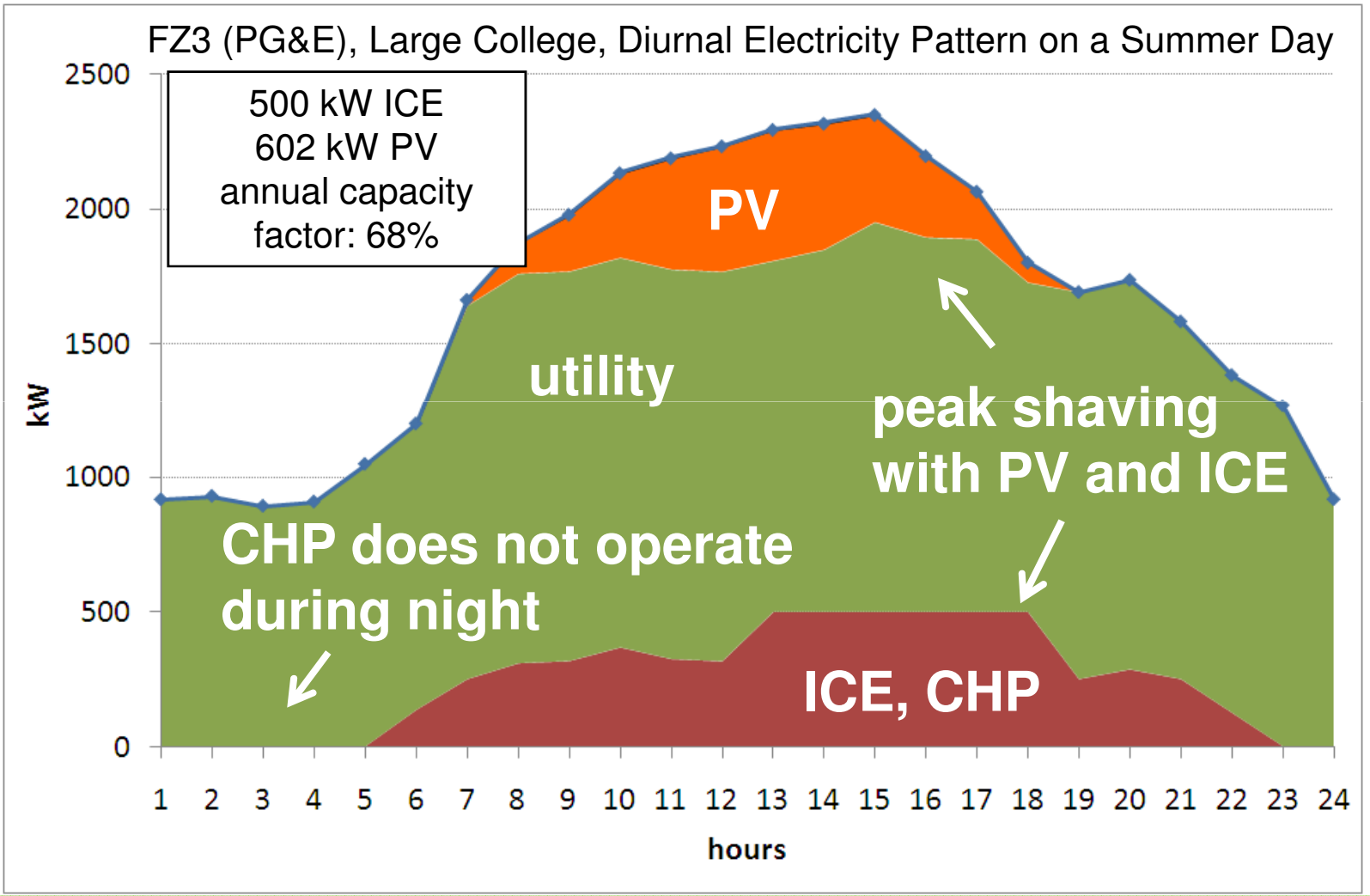
Key Assumptions

- not only CHP is considered, also PV, solar thermal
- technology costs in 2020 are based on "Assumptions to the Annual Energy Outlook", e.g.
  - FC with HX: $2220 - $2770/kW, lifetime: 10 years
  - ICE with HX: $2180 - $3580/kW, lifetime: 20 years
  - PV: $3237/kW, lifetime: 20 years
  - etc.
- natural gas tariffs are constant in real terms
- electricity tariffs from early 2009 / late 2008 are used and constant in real terms
- 6% real interest rate (except one sensitivity run)

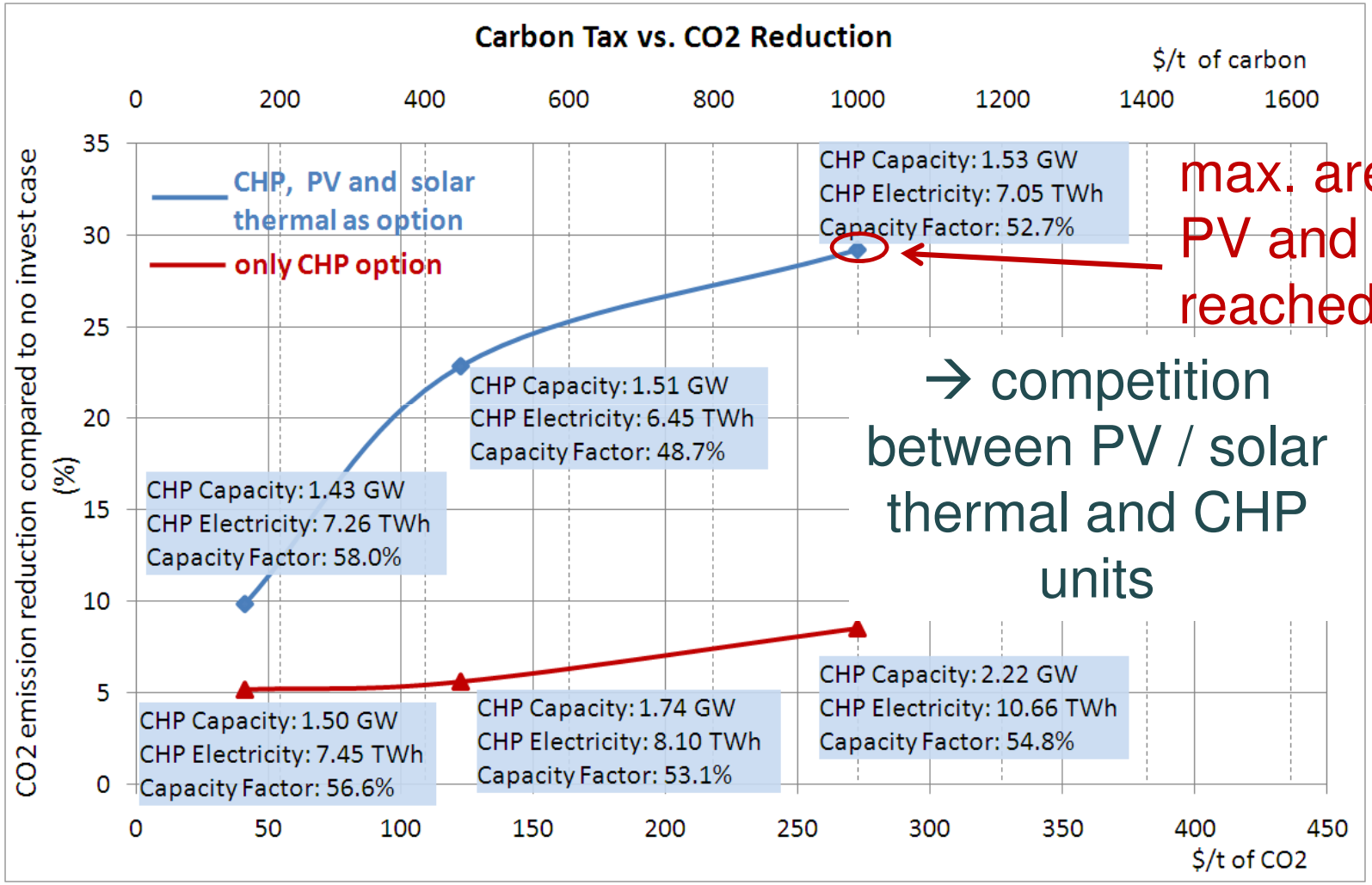
CO_2 Abatement Best Bldgs.
(Reference Case)



Electric Supply Results
(Reference Case)



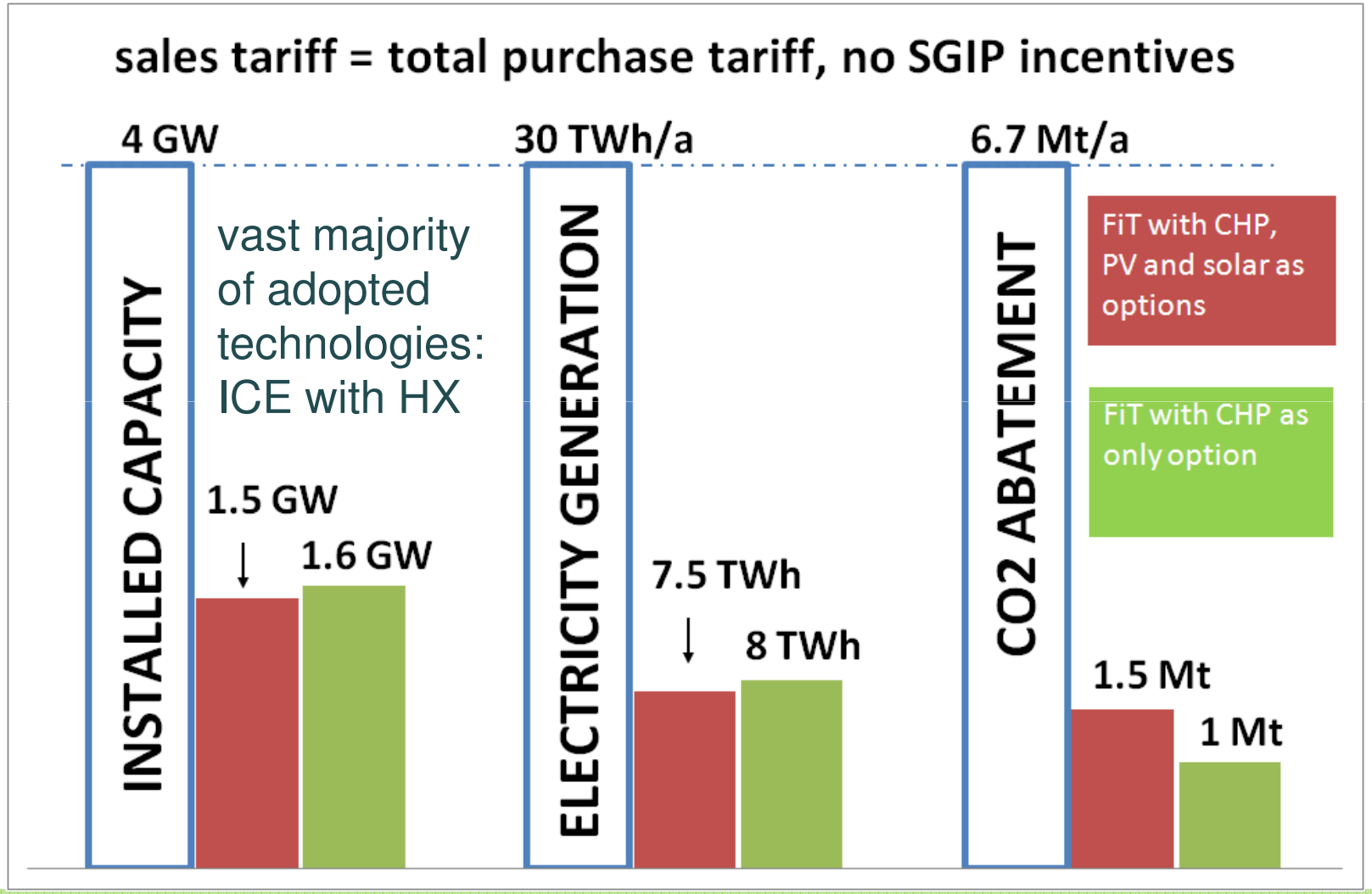
Carbon Tax Cases
(for Considered Midsized Bldgs.)



max. area for PV and solar reached?

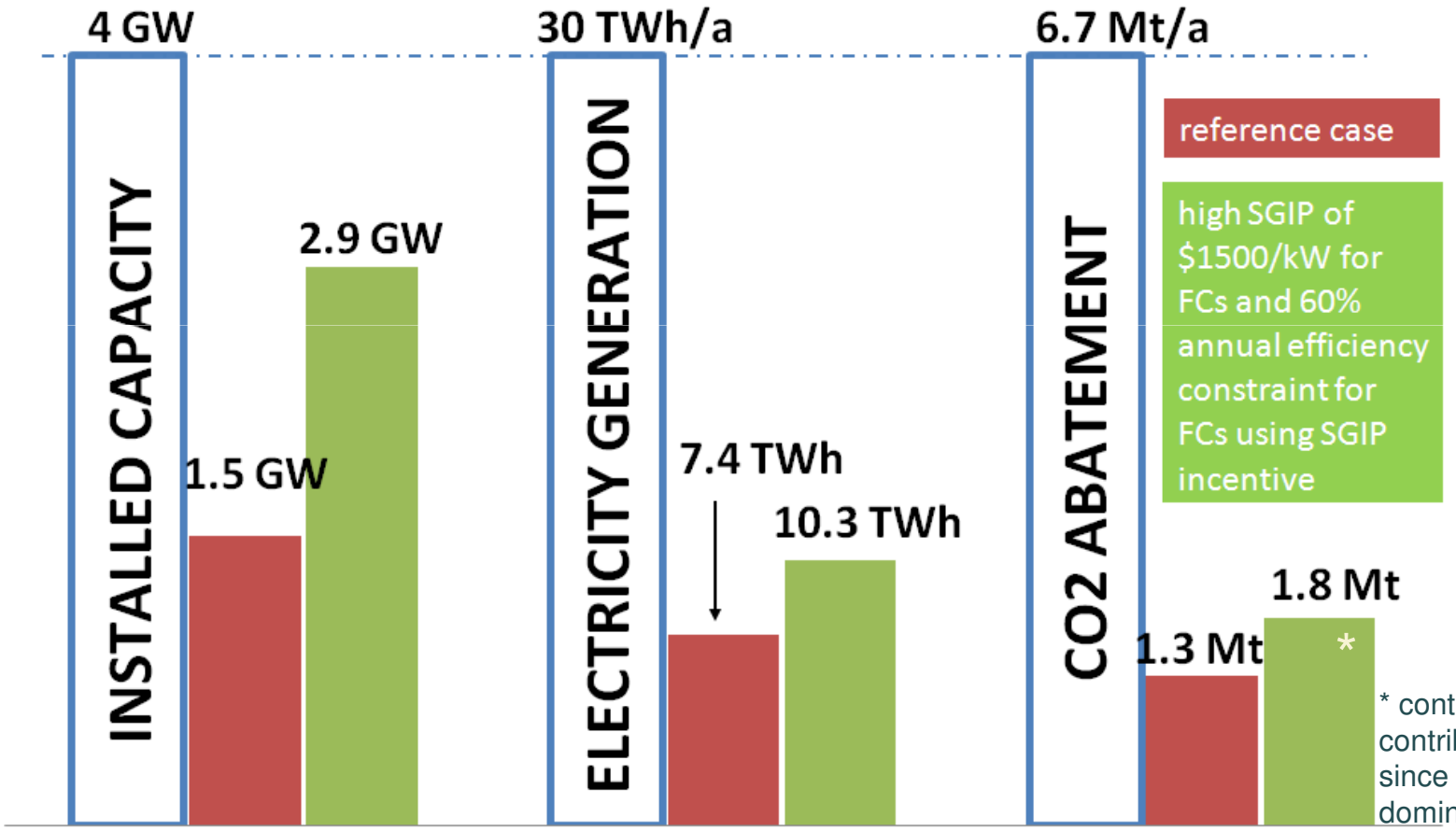
→ competition between PV / solar thermal and CHP units

Feed-in Tariff



High SGIP for FCs versus Reference Case

High SGIP: vast majority of adopted technologies are FCs with HX



* contains a negligible contribution from PV since FCs are very dominant in this case

Observations

- DER-CAM delivers highly variable capacity factors between 30% and 88% depending on the considered site and tariff
  - an average capacity factor of 55% is observed in the reference case
  - high average capacity factors of 86% assumed by ARB in scoping plan appear unrealistic
- The lower observed capacity factors impact the electricity generation from CHP considerably
- Carbon taxes drive CHP and PV / solar thermal adoption

Conclusions

- In the reference case, 1.5 GW of CHP is adopted through 2020 in this analysis of the medium-size commercial sector
  - high SGIP case raises this to 2.9 GW
- FiT slightly increases the energy output from CHP
- SGIP for FCs has a big impact
- Future work:
  - more work on appropriate FiT tariffs and impacts on adoption and capacity factors
  - interaction between PV, solar thermal, and CHP
  - effect of inclusion of storage technologies

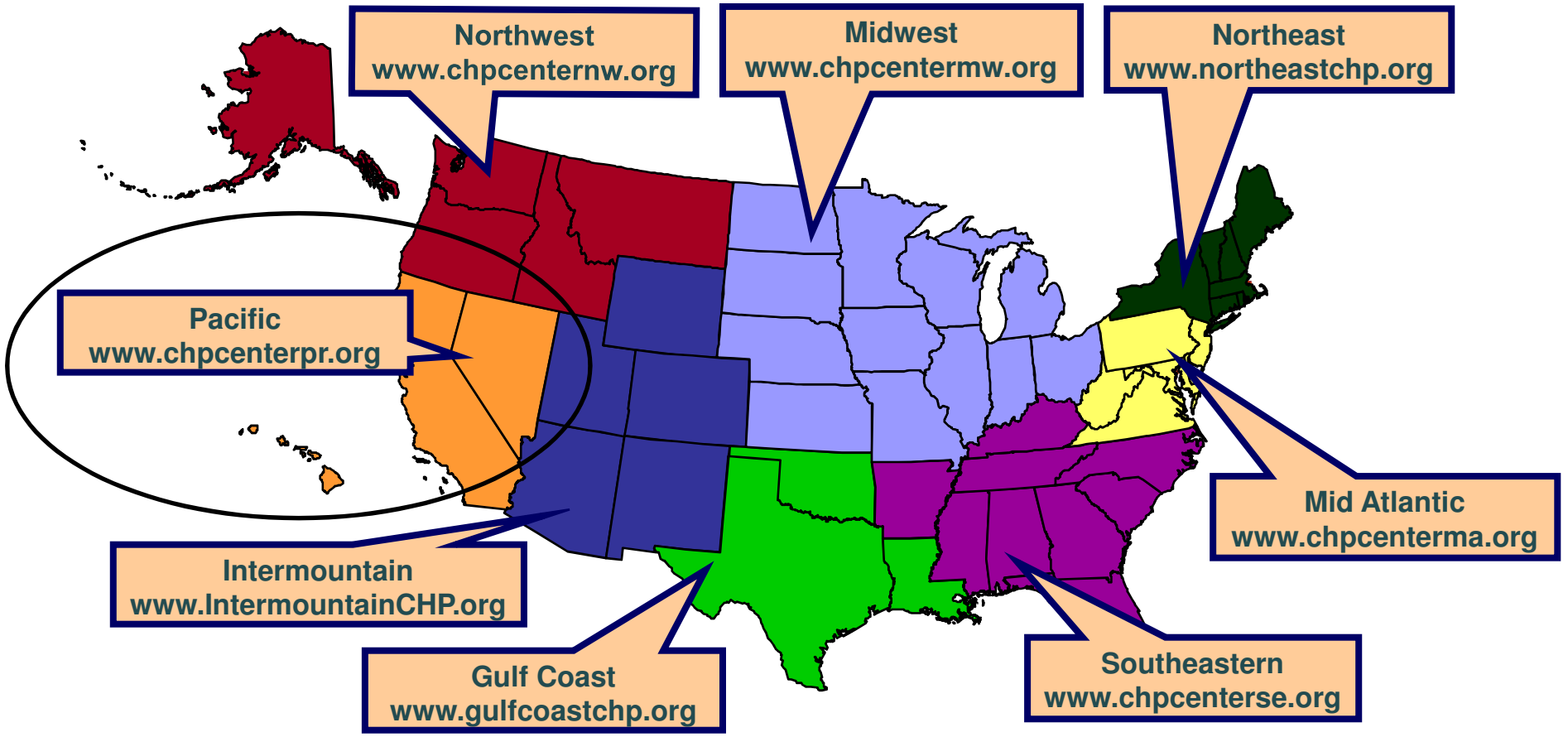
PRAC Update

PRAC Update

- PRAC is the Pacific Region Combined Heat and Power Application Center, operated by UC Berkeley, UC Irvine, and San Diego State University since 2005
- Sponsored by U.S. DOE and the CA Energy Commission, and with involvement from key partners including electric and gas utilities, Berkeley Lab, CA Clean DG Coalition, etc.
- One of eight DOE regional application centers for CHP
- Has conducted a range of educational, outreach, and direct project assistance activities to promote appropriate CHP adoption in the Pacific Region: CA, NV, HI
- PRAC: http://www.chpcenterpr.org

Regional CHP App. Centers

Promoting CHP technology and practices as well as identifying and implementing regional CHP projects



PRAC Update (cont'd)

- The PRAC team has just been awarded a three-year $1.5M continuation grant by the U.S. Department of Energy
- Proposal cost-matched (20%) by the CA Energy Commission, the Energy Biosciences Institute, and the Univ. of California
- New name for the RACs:

  "Pacific Region *Clean Energy* Application Center"
- Still a strong focus on CHP, adding also waste heat-to-power and waste/biogas power applications
- Eventual further expansion into other renewable energy and clean fuels is possible

PRAC Update (cont'd)

Workplan for the new center phase:

- maintain and expand PRAC website
- target market workshops
- waste-heat-to-energy workshop
- revised state "baseline assessment and action plan" reports
- project case study profiles
- policy roadmapping with stakeholders
- identify and facilitate high impact projects
- project management

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Thank you!